

## EVALUATION OF BLACKGRAM (*VIGNA MUNGO* L. HEPPER) GENOTYPES FOR YIELD AND PHYSIOLOGICAL PARAMETERS UNDER DROUGHT CONDITION

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### ABSTRACT

*An experiment was carried out to assess the morpho-physiological traits under drought stress condition in a pot culture. For one set of pots, irrigation was suspended for one week during the flowering stage of the crop, and data on morpho-physiological features of control and water stress plants was collected. For the bulk of the variables, the genotypes with water stress and their interaction differed significantly, indicating the presence of genetic variability. The results showed that the genotype IC436524 recorded highest seed yield and also recorded higher plant height (cm), number of branches per plant, number of leaves per plant, number of clusters per plant, number of pods per plant, pod weight (g), number of seeds per plant and 100 seed weight under irrigated conditions. The genotype IC426766 has recorded lower seed yield and its contributing traits under irrigated conditions while the genotype performed better under drought condition. The genotype IC426766 recorded lower SPAD readings and higher Canopy temperature under irrigated conditions while under drought conditions the genotype recorded higher SPAD readings and lower Canopy temperature which indicates that the genotype maintain coolness and try to escape its drought condition.*

**KEYWORDS:** Blackgram, Canopy temperature, drought stress, SPAD and yield

**Received:** Sep 01, 2021; **Accepted:** Sep 20, 2021; **Published:** Nov 13, 2021; **Paper Id.:** IJASRDEC202128

### INTRODUCTION

Seed yield is most important criteria in pulse crop evolution under drought stress condition. In crop improvement program, it is most important that identifying the yield and yield contributing traits under drought stress condition. Drought stress has an impact on crop yield as well as other morpho-physiological characteristics (Baroowa and Gogoi 2012, 2013; Baroowa et al. 2016; Maheswari et al. 2016). Increased severity and duration of drought stress cause a greater fall in chlorophyll content (Kiani et al. 2008). Drought stress impacts turgor pressure and cell expansion due to a loss of cell turgidity, resulting in poor plant growth (Mondal et al. 2012). Drought stress affects photosynthetic rate as well (Manivannan et al. 2007). Crop plants have a variety of morphological and physiological features that make them resistant to water shortages. It indicates that root cell development, nutrient uptake, and photosynthesis are all influenced by the plant's growth and development (Dhole and Reddy, 2010).

The black gramme (*Vigna mungo* L. Hepper) is a popular food legume with a high nutritional value and a protein content of 24-26 percent. It originated in India, where it has been farmed since ancient times and is considered one of the most valuable pulses in the country. Various environmental conditions, including as temperature, light, water, and nutrient availability, have a significant impact on the growth and development of black gramme plants. Variations in the foregoing elements severely affect plant growth and development, resulting in a dramatic reduction in crop production under abiotic stress conditions. However, several environmental stress factors, particularly drought, have a negative impact on blackgram output (Pandey et al., 2014). Soil moisture stress

is a major hazard for successful crop production throughout the world. When compared to other crop stages, water stress has a significant impact on pulse crop yield production during flowering and post-flowering (Cortes and Suidaria 1986; Uprety and Bhatia 1989). More than 87 percent of pulse-growing land is currently rainfed, and moisture stress is the leading cause of crop failure or low yield realisation. Water deficiency stress has been observed to have a stronger negative influence on pulse crops during the blooming and post-flowering stages than during the vegetative period (Cortes and Suidaria, 1986; Uprety and Bhatia, 1989). In this context, a study was done to evaluate the black gram genotypes for morphological and physiological features at flowering stage to screen the drought tolerant genotypes under control (irrigated) and drought stress conditions.

## MATERIALS AND METHODS

Eleven genotypes of Blackgram accessions, IC261182, IC281981, IC281992, IC382811, IC398989, IC398998, IC426766, IC436508, IC436516, IC436524, and T-9, were collected from NBPGR Regional station, Hyderabad, and grown in a Randomized Block Design in three replications, with three seeds for each genotype sown on the last week of July, 2018 in earthen pots having soil and compost in 3:1 ratio at Experimental farm, Centre for Plant Molecular Biology, Osmania University, Hyderabad. Watering was done on a regular basis, and each pot eventually had one plant in it. The Irrigation were maintained for one regime by providing irrigation at regular intervals while water deficit stress (drought) was imposed at flowering stage by withholding irrigation till wilting symptoms were observed, there after stress was released by irrigating the pots. All the recommended cultural practices were followed for raising a good field crop. The SPAD (Soil Plant Analytical Development) readings (measuring the relative chlorophyll content (SCMR) of leaves) were recorded with SPAD-502 Minolta, Tokyo, Japan and Canopy temperature (CT) was measured using a hand held 568 infrared thermometer at third leaf from the top of the main stem of three randomly selected plants in each replication of selected genotypes and T-9 during water deficit stress (drought) period and yield contributing parameters viz., plant height (cm), number of branches per plant, number of leaves per plant, number of clusters per plant, number of pods per plant, pod weight (g), number of seeds per plant, seed yield per plant (g), 100 seed weight and husk weight (g) were recorded at harvest.

## RESULTS AND DISCUSSIONS

The Combined Analysis of Variance ANOVA results of physiological parameters-SPAD readings and canopy temperature well as yield parameters-plant height, number of branches per plant, number of leaves per plant, number of clusters per plant, number of pods per plant, pod weight, number of seeds per plant, seed yield per plant, 100 seed weight and husk weight were highly significant ( $p < 0.05$ ) for genotypes. For treatments all the yield and physiological parameters were significant except 100 seed weight. All the yield and physiological parameters were significant for genotype x treatment except number of branches per plant and canopy temperature (Table 1). The results revealed that among ten genotype four genotype viz., IC436524 (15.687g/pl) followed by IC436516 (10.657g/pl), IC382811 (8.603g/pl) and IC261182 (8.183g/pl) recorded higher seed yield under irrigated condition. The above four genotypes also recorded higher plant height (cm), number of branches per plant, number of leaves per plant, number of clusters per plant, number of pods per plant, pod weight (g), number of seeds per plant, seed yield per plant (g), 100 seed weight and husk weight (g) under irrigated condition (Table 2). The genotype IC436524 recorded highest SPAD reading (46.8) followed by IC436516 (46.3) and IC382811 (46.3). The above three genotypes recorded lower canopy temperature (34.7, 36.2 and 36.4) respectively under irrigated condition. Similar observations were recorded in sorghum (Devkumaret al., 2014) and in cowpea genotypes (Hayatuet al., 2010) the percentage of reduction in chlorophyll content in moderate stress ranged from 6.64% to 24.5.

Under drought condition the genotype IC436766 recorded highest seed yield (6.438g/pl) followed by IC261182 (4.351g/pl). These two genotypes also recorded higher plant height (23.67cm, 20.53cm), number of leaves per plant (11.67, 10.67), number of clusters per plant (13.33, 11.00), number of pods per plant (42.67, 30.00), pod weight (13.99g, 9.97g), number of seeds per plant (179, 120.76) and 100 seed weight (3.59g, 3.60g) respectively (Table 3). These two genotypes also recorded higher SPAD readings (39.10, 35.80) and lower canopy temperature (33.73, 35.26) respectively. Drought resistant chickpea cultivars produced the maximum seed output under drought stress, while drought sensitive cultivars produced the lowest, according to Mafakheri et al. (2010). It was interesting to note that genotypes with higher seed output and contributing characteristics under irrigated conditions had lower seed yield and contributing characteristics in drought conditions. Similar findings were previously discovered in legumes (Bhatt and Srinivasa Rao 2005; Baroowa and Gogoi 2012). Drought stress causes defoliation and stops the formation of new leaves, resulting in fewer leaves (Mwale et al. 2007). In blackgram, Hussain et al. (2013) found that pod number reduced when there was a water shortage. According to Gurumurthy et al. (2019), water stress reduced the number of leaves, pods, shoot and root dry weight much more than control, with the drop being particularly pronounced in the case of shoot and root dry weight. As a result, dry spells during the flowering stage tend to have a greater impact on black gramme yields. Wang et al (2003). have observed similar effects. Vice versa the two genotype (IC436766, IC261182) were recorded lower seed yield. Hussain *et al.* (2015) also observed decreased seed number in chickpea under water deficit stress conditions with significant genotypic variability and yield contributing characters under irrigated condition but were recorded higher seed yield and its contributing characters under drought condition. Hence, the two genotypes IC436766, IC261182 could be utilised in crop improvement programme to develop drought tolerance lines in blackgram.

**Table 1: Analysis of Variance of Genotypes and Treatments for Quantitative Characters and Physiological Parameters in Black Gram under Irrigated and Drought Stress Conditions**

Source of variations	DF	MSSQ											
		Quantitative Characters										Physiological Parameters	
		PH	Br/pl	LN/pl	CL/pl	PD/pl	PDW	SDN	SDW	100SD W	HKW	SPAD	CT
Genotypes	10	17.016**	1.776**	3.736**	18.248**	300.579**	38.791**	13538.376**	17.675**	0.146**	7.305**	39.072**	11.586**
Treatments	1	746.055**	15.515**	104.379**	210.970**	9867.409**	1242.369**	437411.045**	454.655**	0.004NS	194.052**	405.530**	18.244*
Genotypes X Treatments	10	15.758**	0.982NS	4.579**	24.370**	447.276**	55.771**	15952.612**	20.229**	0.069*	12.013**	42.088**	4.774NS
Error	42	2.439	0.481	0.744	1.589	16.911	1.998	369.602	0.418	0.029	0.757	6.320	3.330
Total	65	18.245	1.042	3.367	11.115	278.922	35.097	11538.117	13.132	0.052	6.483	23.347	5.135
CV(%)	-	7.56	19.22	8.59	13.29	13.02	13.39	12.63	12.92	5.17	15.67	6.72	4.99

\*Significant at 0.05% and \*\* at 0.01 % level, respectively

DF-Degree of Freedom; PH- Plant height; Br/pl-Branches per plant; LN/pl-Leaves number per plant; CL/pl- Clusters per plant; PD/pl-Pods per plant; PDW-Pod weight; SDN-Seed number per plant; SDW-Seed yield; 100SDW-100 seed weight; HKW-Husk weight; SPAD-Chlorophyll readings; CT-Canopy temperature.

**Table 2: Mean performance of Quantitative Characters and Physiological Parameters in Blackgram Genotypes under Irrigated Conditions**

Genotypes	PH	Br/pl	LN/pl	CL/pl	PD/pl	PDW	SDN	SDW	100SDW	HKW	SPAD	CT
IC261182	22.5	5.0	12.0	10.0	41.7	14.63	252.3	8.183	3.511	6.45	41.70	37.26
IC281981	24.0	3.3	10.7	9.7	33.0	11.62	163.0	5.193	3.180	6.43	36.97	35.96
IC281992	22.8	3.3	9.7	7.7	34.7	11.63	170.7	5.483	3.211	6.14	37.20	38.93
IC382811	25.7	5.0	12.0	10.0	53.0	18.37	265.3	8.603	3.242	9.76	46.27	36.43
IC398989	21.5	3.7	11.3	12.7	38.3	12.84	189.0	6.083	3.218	6.76	35.17	36.69
IC398998	22.0	4.3	11.7	9.7	36.7	12.27	200.0	6.537	3.268	5.73	34.97	35.79
IC426766	25.0	4.0	10.7	9.0	36.0	11.80	214.3	6.897	3.218	4.90	35.27	34.23
IC436508	23.2	3.7	11.0	11.7	36.0	11.43	177.0	5.780	3.266	5.65	39.27	34.96
IC436516	26.0	4.3	12.3	13.0	53.0	17.77	317.3	10.657	3.556	7.11	46.33	36.23
IC436524	27.9	4.7	12.7	18.7	77.0	27.10	460.7	15.687	3.674	11.41	46.80	34.66
T-9	23.6	3.7	10.3	12.0	42.7	14.38	160.3	4.785	3.156	9.60	38.70	35.53
Mean	24.0	4.1	11.3	11.3	43.8	14.89	233.6	7.626	3.318	7.27	39.88	36.06
Min	21.5	3.3	9.7	7.7	33.0	11.4	160.3	4.8	3.2	4.9	35.0	34.2
Max	27.9	5.0	12.7	18.7	77.0	27.1	460.7	15.7	3.7	11.4	46.8	38.9
SD	1.952	0.616	0.924	2.947	12.961	4.730	89.964	3.186	0.176	2.058	4.677	1.308
SE	0.588	0.186	0.279	0.889	3.908	1.426	27.125	0.961	0.053	0.620	1.410	0.394

DF-Degree of Freedom; PH- Plant height; Br/pl-Branches per plant; LN/pl-Leaves number per plant; CL/pl- Clusters per plant; PD/pl-Pods per plant; PDW-Pod weight; SDN-Seed number per plant; SDW-Seed yield; 100SDW-100 seed weight; HKW-Husk weight; SPAD-Chlorophyll readings; CT-Canopy temperature.

**Table 3: Mean Performance of Quantitative Characters and Physiological Parameters in Blackgram Genotypes under Drought Stress Conditions**

Genotypes	PH	Br/pl	LN/pl	CL/pl	PD/pl	PDW	SDN	SDW	100SDW	HKW	SPAD	CT
IC261182	20.5	4.3	10.7	11.0	30.0	9.97	120.7	4.351	3.606	5.62	35.80	35.26
IC281981	18.2	2.7	8.3	6.7	17.3	5.53	64.3	2.035	3.166	3.49	36.33	38.29
IC281992	15.6	3.0	9.0	5.3	14.0	4.47	51.7	1.615	3.094	2.85	34.87	39.26
IC382811	16.2	3.0	7.7	6.0	15.3	4.89	56.3	1.716	3.007	3.18	30.90	39.43
IC398989	14.8	3.3	6.7	7.0	15.0	4.79	56.0	1.970	3.513	2.81	32.83	38.69
IC398998	17.3	3.0	8.3	7.3	16.3	5.21	60.0	1.947	3.232	3.26	33.10	36.13
IC426766	23.7	4.7	11.7	13.3	42.7	13.99	179.0	6.438	3.599	7.56	39.10	33.73
IC436508	16.8	2.3	8.3	6.7	13.0	4.15	43.0	1.404	3.267	2.74	34.77	36.29
IC436516	15.2	2.7	8.0	6.7	14.3	4.57	46.3	1.548	3.339	3.02	36.57	36.89
IC436524	16.7	2.7	9.3	7.3	15.7	5.00	45.7	1.531	3.351	3.47	36.50	38.99
T-9	15.3	2.7	8.7	7.3	19.3	5.81	56.0	1.593	3.150	4.22	33.33	35.27
Mean	17.3	3.1	8.8	7.7	19.4	6.22	70.8	2.377	3.302	3.84	34.92	37.11
Min	14.8	2.3	6.7	5.3	13.0	4.1	43.0	1.4	3.0	2.7	30.9	33.7
Max	23.7	4.7	11.7	13.3	42.7	14.0	179.0	6.4	3.6	7.6	39.1	39.4
SD	2.667	0.734	1.385	2.350	9.017	3.026	41.676	1.576	0.202	1.485	2.276	1.934
SE	0.804	0.221	0.417	0.708	2.719	0.912	12.566	0.475	0.061	0.448	0.686	0.583

DF-Degree of Freedom; PH- Plant height; Br/pl-Branches per plant; LN/pl-Leaves number per plant; CL/pl- Clusters per plant; PD/pl-Pods per plant; PDW-Pod weight; SDN-Seed number per plant; SDW-Seed yield; 100SDW-100 seed weight; HKW-Husk weight; SPAD-Chlorophyll readings; CT-Canopy temperature.

## ACKNOWLEDGEMENT

The present research work is part of Ph.D. thesis work. We acknowledge the Osmania University, Hyderabad for providing both field and lab facilities to conduct experiments. We also acknowledge NBPGR, Regional Centre, Hyderabad for providing seed material of blackgram germplasm.

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